**Significant digits**

Suppose you measured the mass of a rock to be 6.78 g and its volume to be 2.3 cm$^3$. How accurately can you determine its density?

Density = mass/volume = (6.78 g)/(2.3 cm$^3$) = 2.947826087 g/cm$^3$

What’s wrong with this calculation? All those extra digits are not science, but fiction! The density is NOT known to such precision, given the relatively crude mass and volume measurements.

When **multiplying or dividing**, the answer should be reported with the same number of significant digits as the number in the calculation with the fewest significant digits. In this case, that’s the volume measurement with only two sig figs, so the density should be reported as 2.9 g/cm$^3$.

If this is an intermediate calculation that is part of a multi-step calculation, it is wise to keep one extra digit for now (2.95), but then report the final answer with two sig figs.

When quantities are being **added or subtracted**, the answer should be reported with the same number of *decimal places* (not significant digits) as the number in the calculation with the fewest decimal places. *Example*: 50.01 – 45.5 = 4.5 (not 4.51).

**Unit conversion**

Scientific calculations often require conversions between units. Two simple rules should always be followed when converting a number:

1. Multiply the number by conversion fractions that are each equal to 1.

2. Make sure that the same units are on opposite sides of the fractions, so that they cancel out.

**Example**: Convert 15 km/hr into m/s.

\[
\begin{align*}
15 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ s}} &= 4.2 \text{ m/s}
\end{align*}
\]

Note that each conversion fraction is equal to one (numerator = denominator, e.g. 1000 m = 1 km). The units km, hr, and min all cancel, leaving m/s.

Note also a special case for sig figs here. Although 1000, 60, and 1 all look like they only have one sig fig, each one is really an *exact number* with infinite sig figs: by definition, there are exactly 1000 m in 1 km, and exactly 60 min in 1 hr.